INSTRUCTION MANUAL
MODEL 25A
POWERMETER CALIBRATOR

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TABLE OF CONTENTS

SECTION I - INTRODUCTION

Paragraph		Page
1-1.	Scope of Manual	1
1-3.	Purpose and Use of Equipment.	1
1-5.	Traceability.	1

SECTION II - OPERATION

Paragraph		Page
2-1.	General	2
2-3.	Installation.	2
2-4.	Unpacking	2
2-5.	Mounting.	2
2-6.	Power Requirements.	2
2-7.	Cable Connections	2
2-8.	Operating Controls and Connectors	2
2-10.	Power Application	2
2-12.	Operating Procedure	5
2-14.	Zeroing Procedure	5
2-15.	Load Matching Considerations.	5

SECTION III - THEORY OF OPERATION

Paragraph		Page
3-1.	General	6
3-3.	1 MHz Oscillator.	6
3-4.	Power Amplifier	6
3-5.	Low Pass Filter	6
3-6.	AGC Loop.	6
3-7.	Reference	6
3-8.	Precision Attenuator.	6
3-9.	Power Supply.	6

SECTION IV - MAINTENANCE

Paragraph		Page
4-1.	General	8
4-3.	Assembly and Component Identification	8
4-4.	Required Test Equipment	8
4-5.	Performance Checks.	8
4-6.	Calibration Accuracy.	8
4-7.	Attenuator Tracking (+20 to -60 dBm).	8
4-8.	Calibration Procedure	9
4-9.	Power Supply.	9
4-10.	0 dBm, -9 dBm Adjustment.	9
4-12.	Troubleshooting	9
4-13.	Schematic Diagrams.	10
4-14.	Troubleshooting Procedure	10
4-15.	Power Supply and Reference Circuits (A3).	10
4-16.	Oscillator and AGC System (A2).	10
4-17.	Attenuator Assembly (A1).	10

SECTION V - PARTS LIST

Paragraph		Page
5-1.	Table of Replaceable Parts.	14

SECTION VI - SCHEMATIC DIAGRAMS

Figure		Page
6-1	Oscillator P.C. Board A2.	17
6-2	Switch P.C. Board A3.	18
6-3	Mainframe Schematic	19

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Model 25A Power Meter Calibrator	iii
2-1	Controls and Connectors Used During Operation	3
2-2	Controls and Connectors Used During Operation	4
3-1	25A Block Diagram	7

LIST OF ILLUSTRATIONS (CONT.)

Figure		Page
4-1	Location of Principal Sub-Assemblies.	11
4-2A	DC Micropotentiometer Test Set-Up	12
4-2B	AC Micropotentiometer Test Set-Up	12
4-3	Model 25A Downscale Test Set-Up	12
4-4	Attenuator Tracking Test Set-Up	13

LIST OF TABLES

Table		Page
1-1.	Performance Specifications	1
2-1.	Operating Controls, Indicators and Connectors.	5
4-1.	Sub-Assembly Functions	8
4-2.	Required Test Equipment	9
4-3.	Calibration Levels	9

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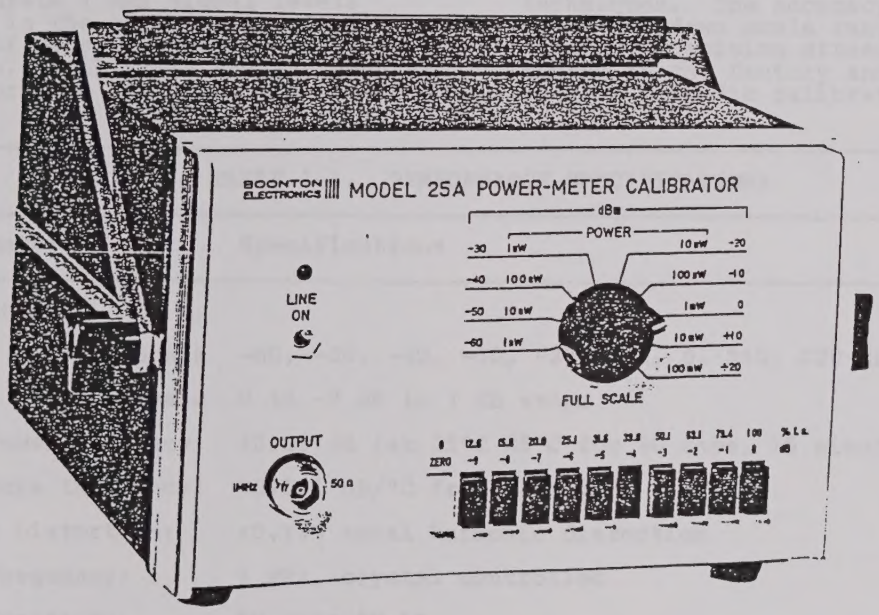
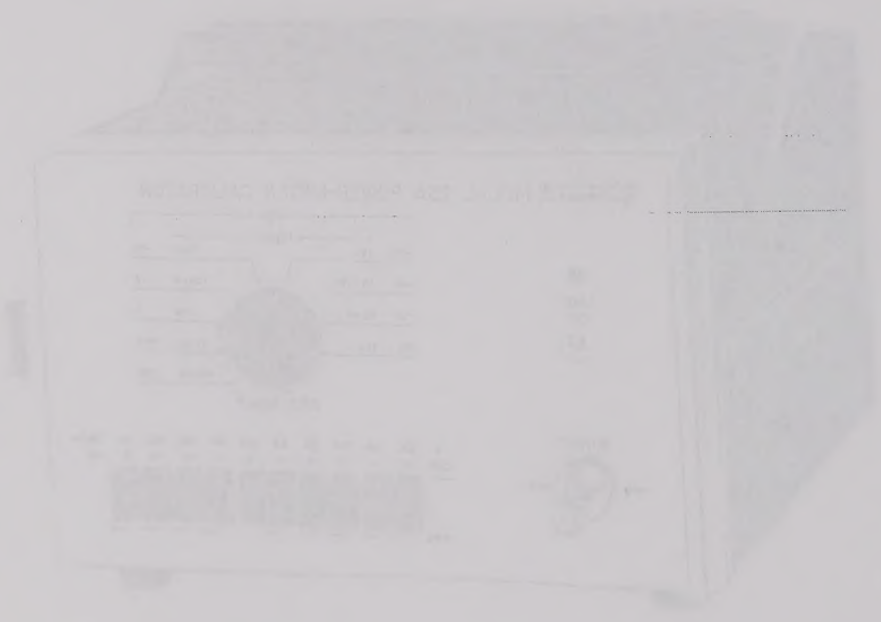


Figure 1-1

Model 25A Power Meter Calibrator



SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual provides descriptive data, operating instructions, theory of operation, maintenance instructions, schematics, and a parts list for the Model 25A Power Meter Calibrator.

1-3. PURPOSE AND USE OF EQUIPMENT.

1-4. The Model 25A is a precision, solid-state instrument designed to provide accurate 1 MHz signal levels required in the calibration of all Boonton RF microwattmeters, Model 41 and 42 series. Full scale and incremental values for each range are provided, allowing verification and calibration of both full scale and down scale indications.

1-5. TRACEABILITY.

1-6. The Model 25A is factory calibrated using instrumentation whose accuracy is traceable to the National Bureau of Standards. Periodic calibration of 0 dBm and -9 dBm outputs is accomplished using thermal transfer techniques. The accuracy of other full scale and down scale ranges is determined by precision attenuators which are tested at the factory and should not require periodic calibration.

TABLE 1-1. PERFORMANCE SPECIFICATIONS

Parameter	Specifications
Power Ranges:	
Full Scale	-60, -50, -40, -30, -20, -10, 0, ±10, ±20 dBm
Down Scale	0 to -9 dB in 1 dB steps
Output Power Accuracy:	±0.05 dB (at 25°C ±5°C for 90 days, 15 minute warm-up)
Temperature Influence:	±0.001 dB/°C from 0 to 50°C
Harmonic Distortion:	<0.15% total harmonic distortion
Output Frequency:	1 MHz, crystal controlled
Output Impedance:	50 ohms ±0.5%
Temperature:	
Operating	0 to 50°C
Non-operating	-20 to 75°C
Input Power:	100, 120, 200, 240 VAC ±10% 50 to 400 Hz, 7 VA
Dimensions:	5.2" high (without feet), 8.3" wide, 11.5" deep (132 x 211 x 292 mm)
Weight:	7.75 lbs. (3.6 kg)

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section contains instructions for the installation and operation of the Model 25A Power Meter Calibrator.

2-3. INSTALLATION.

2-4. UNPACKING. The Model 25A is shipped complete and is ready for use upon receipt. Unpack the equipment from the shipping container and inspect it for damage that may have occurred during shipment. Check that all operating controls operate over their full range without binding.

NOTE

Save the packing material and container for possible use in reshipment of the equipment.

2-5. MOUNTING. For bench mounting, choose a clean, sturdy, uncluttered mounting surface. For rack mounting, an accessory package is required. The accessory rack mounting kit, Model 92-1A, will mount a single Model 25A in either a right or left hand configuration. The accessory rack-mounting kit, Model 92-1B, will mount two Model 25A's, or a single Model 25A plus an additional half-rack Boonton instrument, such as a Model 42 Microwattmeter.

NOTE

Feet and bail may be removed from the bottom of the instrument to clear adjacent rack mounted units.

2-6. POWER REQUIREMENTS. A 100, 120, 200, or 240 volt, 50 to 400 Hz, single phase, AC power source is required for operation of the Model 25A. Power required is 7 VA.

CAUTION

The line voltage selector switch must be set to the correct position most nearly corresponding to the voltage of the available AC power source, and a fuse of correct rating must be installed in the fuse holder before connecting the instrument to any AC power source. Refer to the Safety Summary located in the front of this manual.

2-7. CABLE CONNECTIONS. Connecting cables are not supplied with the equipment. The output connector of the Model 25A is a Type N female. The input connector of any Boonton power detector will connect directly to the output connector of the Model 25A. If a connecting cable is required because of a remote position of the power detector to the Model 25A, this cable should have a 50 ohm characteristic impedance and be short as possible to avoid attenuation errors.

2-8. OPERATING CONTROLS AND CONNECTORS.

2-9. All controls and connectors used during operation of the Model 25A are shown in Figures 2-1 and 2-2. Table 2-1 lists their functions.

2-10. POWER APPLICATION.

2-11. The Model 25A is designed for operation from either a 100, 120, 200, or 240 volt, 50 to 400 Hz, AC power source. To apply power, proceed as follows:

a. Determine the line voltage at the power output receptacle. Slide the plastic cover on the rear panel power assembly to uncover the section that houses the fuse. Look at the small printed circuit card located below the fuse and note the three digits that appear at the left corner of this board. If these digits agree with the line voltage to be applied, the instrument is ready for power application. If these digits do not agree with the line voltage, remove the board with small pliers and rotate and/or turn the board until the three digits in the left corner agree with the line voltage. Insert the board in this position.

b. Check the value of the fuse in the rear panel fuseholder. For 100 or 120 volt operation, the fuse should be a 0.1 ampere, MDL Slo-Blo type; for 200 or 240 volt operation, a 0.06 ampere, MDC Slo-Blo type. If the rating of the fuse is incorrect for the available line voltage, install a fuse of the proper rating in the fuseholder. Slide the plastic cover back over the fuseholder.

WARNING

The Model 25A is designed to operate from a 3-terminal (one ground) AC power receptacle. To eliminate a potential shock hazard to operating personnel, use a 3-prong to 2-prong adapter if only a 2-terminal AC power receptacle is available. Connect the ground wire of the adapter to the power receptacle ground.

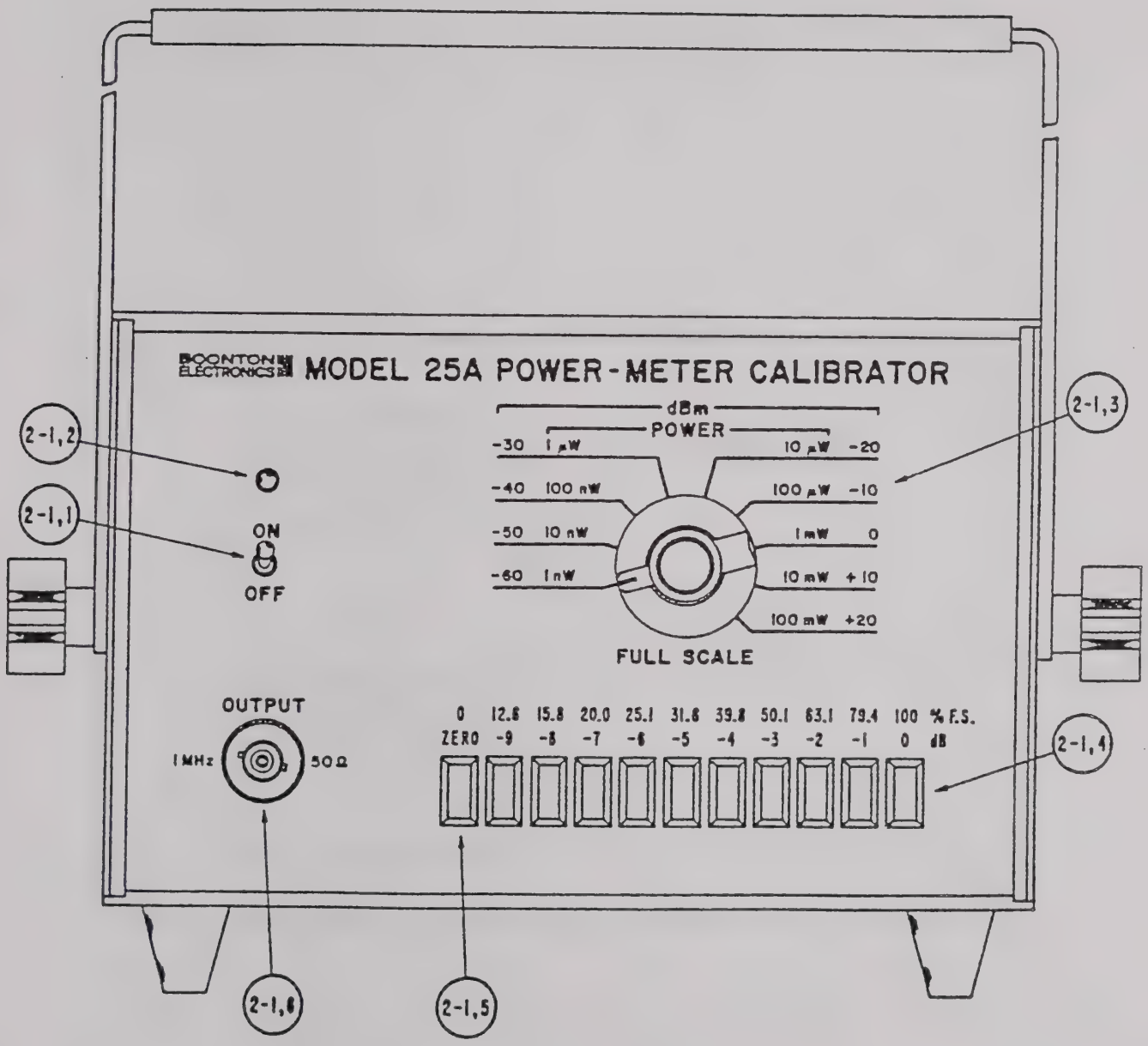


Figure 2-1. Controls and Connectors Used During Operation

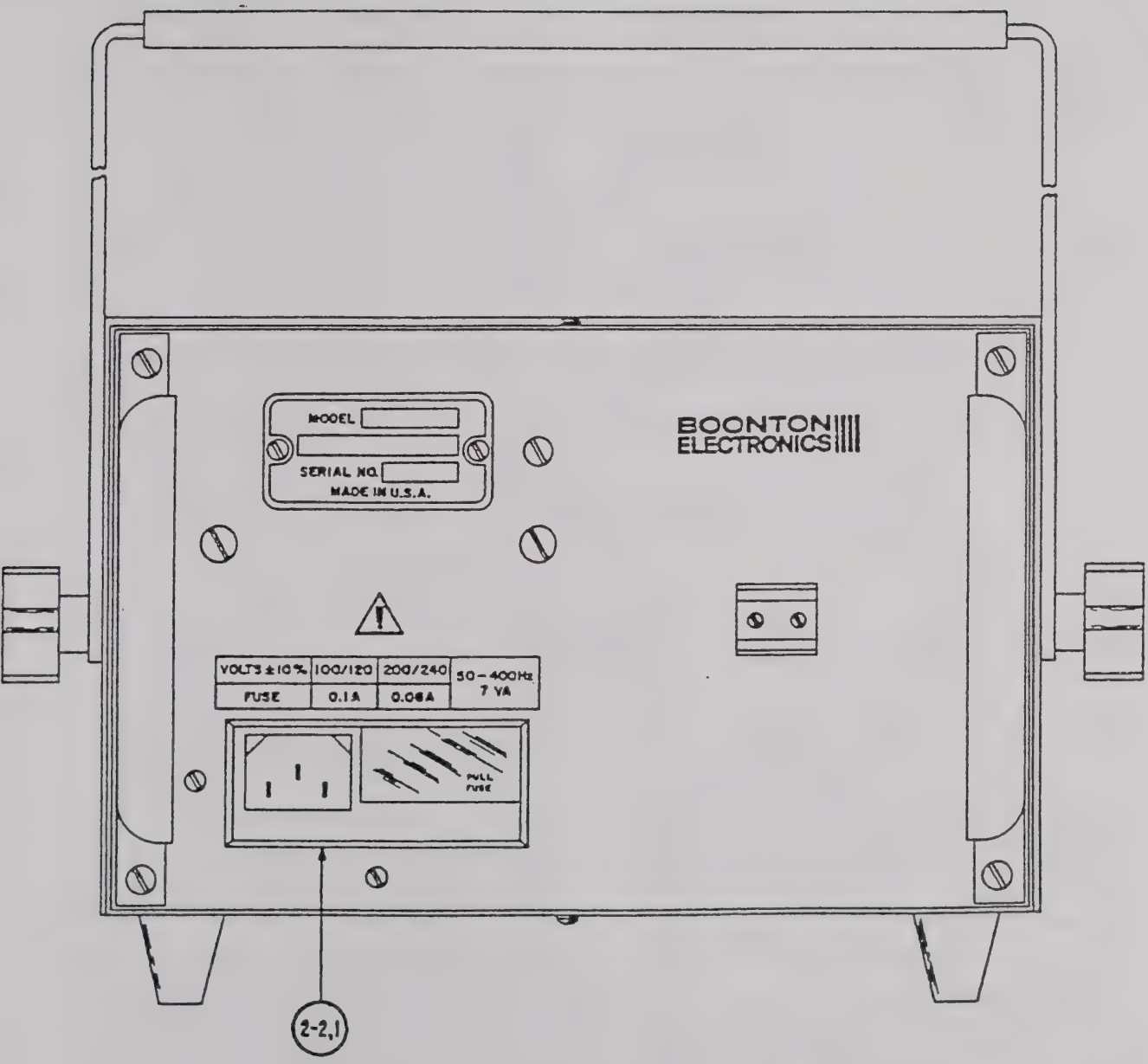


Figure 2-2. Controls and Connectors Used During Operation

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

Control, Indicator or Connector	Figure and Index No.	Function
LINE ON Switch	2-1, 1	Permits operator to control application of input AC power.
LINE ON Indicator	2-1, 2	Indicates that AC power is applied to the equipment.
FULL SCALE Switch	2-1, 3	Permits operator to select output power in full-scale steps.
POWER	2-1, 3	Indicates full-scale steps in decade units of power from 1 nW to 100 mW.
dBm	2-1, 3	Indicates full-scale steps in 10 dB increments from -60 to +20 dBm.
%FS Pushbutton Switches	2-1, 4	Permits operator to select down scale increments on any full-scale range from 100% to 12.6%.
dB Pushbutton Switches	2-1, 4	Permits operator to select down scale increments on any full-scale range from 0 dB to -9 dB in 1 dB steps.
ZERO Pushbutton	2-1, 5	Reduces the output of the generator to zero, allowing the operator to adjust the zero control on the microwattmeter under test.
OUTPUT Connector	2-1, 6	Type N female connector for connection to the instrument under test.
Line Cord/Fuse Assembly	2-2, 1	Permits conversion of AC input to proper voltage and fuse ratings, as well as providing recessed terminals for connecting the detachable line cord.

c. Connect the detachable power cord of the Model 25A to the instrument and to the AC power receptacle (with adapter, if required).

2-12. OPERATING PROCEDURE.

2-13. The operating procedure for the Model 25A is simple and straight forward. There are no panel adjustments and no meter indications to consider.

The 1 MHz output power is directly set by a combination of the panel-mounted FULL SCALE rotary switch and the % FS/dB pushbutton switches. The specific order in which these switches are operated depends on the instrument under test and the particular ranges or indications of the instrument that are to be checked or calibrated. If a full check or calibration is to be made of the instrument under test, the sequence of output levels is described in the instruction manual for that instrument.

2-14. ZEROING PROCEDURE. As described in the instruction manual of the instrument under test, the instrument and its power detector should be operated for a long enough period to reach thermal equilibrium, and then the instrument should be zeroed on its most sensitive range, following the procedure outlined in the instruction manual. The white ZERO pushbutton switch on the Model 25A provides a convenient method of establishing a zero power level when the instrument and its power detector are connected to the Model 25A.

2-15. LOAD MATCHING CONSIDERATIONS. The output jack of the Model 25A provides a 50 ohm source impedance. The output power levels established by the panel switches of the Model 25A will be correct only when the Model 25A is connected to a 50 ohm load, such as a Boonton Series 41 Power Detector.

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

3-2. The block diagram of the Model 25A is shown in Figure 3-1. The major components are the 1 MHz oscillator, power amplifier, low-pass filter, AGC loop, voltage reference, precision attenuator, and power supply.

3-3. **1 MHz OSCILLATOR.** (Refer to the schematic at the end of this manual.) A 1 MHz crystal-controlled oscillator is formed by the interconnection of A2 IC1A, A2 IC1B and crystal A2 Y1. During normal operation pin 12 of A2 IC1 is held at +5 volts. When the front panel ZERO button is depressed; however, this pin is grounded, thereby inhibiting oscillation. A2 IC1C buffers the oscillator and the power amplifier.

3-4. **POWER AMPLIFIER.** The signal from A2 IC1C drives the base of A2 Q2 which causes collector current to be switched at a 1 MHz rate. A2 L3, A2 L4, A2 C9, and A2 C10 insure proper coupling to the low pass filter. A2 CR3 prevents large negative voltages on the collector of A2 Q2.

3-5. **LOW PASS FILTER.** The low-pass filter consists of A2 L5-L7, and A2 C11-C14. The purpose of this filter is to reduce harmonic content in the output signal.

3-6. **AGC LOOP.** The peak voltage at the junction of A2 L7 and A2 R20 is coupled to pin 2 of amplifier A2 A2 via diode detector A2 CR4. An equal DC voltage is applied to pin 3 of A2 A2 via A2 CR2. A2 CR2 and A2 CR4 are matched and loaded to provide optimum temperature performance. Capacitor A2 C8 provides necessary loop compensation. Pin 6 of A2 A2 provides the collector voltage of A2 Q2 through emitter follower A2 Q3 and current limit transistor A2 Q4. Excessive collector current through Q2 causes A2 Q4 to conduct and reverse bias A2 Q3. This normally occurs when the calibrator output is shorted. This integral feedback-loop connection makes the junction of A2 L7 and A2 R20 appear as a voltage source which tracks the DC reference voltage with virtually no offset. A2 R20 now determines the output impedance of the power amplifier.

3-7. **REFERENCE.** The primary voltage reference is A2 CR1. The voltage cross A2 CR1 is applied to a precision voltage divider and calibration pot. The precision divider formed by A2 R5-R14 provides nine 1 dB increments below full scale. Full scale reference is set with the calibration pot A3 R4. The proper down scale reference is available at the divider taps. This voltage is then applied to pin 3 of amplifier A2 A1 which is connected to have a modest amount of gain. A2 R3 adjusts the input offset of A2 A1. The voltage at pin 6 of A2 A1 is equal to the peak output voltage required.

3-8. **PRECISION ATTENUATOR.** This portion of the instrument provides the full-scale power settings, resistors R2-R12 are arranged in π-section, 50 Ω, precision pads. There are two 30 dB pads, one 20 dB pad and one 10 dB pad. These are connected individually or in combinations to provide the 80 dB range required.

3-9. **POWER SUPPLY.** The AC voltage from T1 is converted to DC by CR1 and C1. A regulator circuit consisting of A3 IC1 and A3 A1 provides a 15 volt ±0.1 volt output to the oscillator assembly. An additional 5 volt supply is generated by A2 Q1 and associated components for the oscillator integrated circuit.

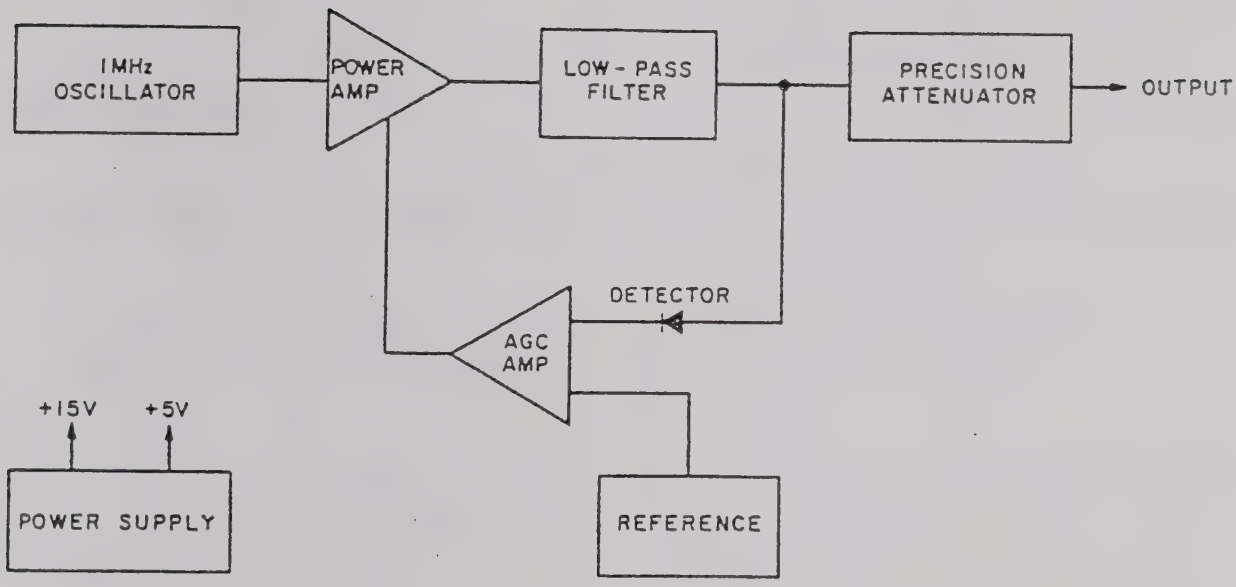


Figure 3-1. 25A Block Diagram

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance and calibration instructions for the Model 25A. The specific items covered are:

a. Assembly and component identification.

b. Required test equipment.

c. Performance checks.

d. Adjustment and calibration.

4-3. ASSEMBLY AND COMPONENT IDENTIFICATION.

a. Figure 4-1 identifies the physical location of the principal subassemblies. Table 4-1 lists the sub-assembly function.

b. Components are identified by their designator numbers. A component can be quickly located by referring to Figure 4-1 to locate the assembly, and to the schematic drawing.

TABLE 4-1.
SUB-ASSEMBLY FUNCTIONS

ASSEMBLY	DESCRIPTION
A1	Precision Attenuator
A2	Oscillator PC Board
A3	Switch Attenuator

4-4. REQUIRED TEST EQUIPMENT. Table 4-2 is a list of equipment required to test and calibrate the Model 25A. Also in this table is a list of pertinent specifications if a substitution has to be made for the recommended piece of equipment.

4-5. PERFORMANCE CHECKS. Sections 4-6 and 4-7 recommend methods to verify the Model 25A specifications outlined in the beginning of this manual. It is important to allow 5 minutes warm-up prior to beginning these checks. These performance checks, in addition to providing verification of Model 25A specifications, can also be used to locate problem areas when the Model 25A is malfunctioning.

4-6. CALIBRATION ACCURACY 0 TO -9 dBm.

a. Connect equipment as shown in Figure 4-2A.

b. Adjust the DC source until DC Voltmeter reads 0.2236 volt and adjust Differential Voltmeter for a null.

c. Connect equipment as in Figure 4-2B and adjust 1 MHz source until Differential Voltmeter reads as in b.

d. Record reading of DC Voltmeter.

e. Repeat a. through d. using voltages and micropotentiometers shown in Table 4-3.

f. Connect equipment as in Figure 4-3. Set Model 25A controls to 0 dBm full scale 100% F.S.

g. Read DC Voltmeter and compare with reading in d. above. Voltages should be within ±0.57%.

h. Repeat f. and g. above for Model 25A steps listed in Table 4-3. Agreement should be ±0.57%.

4-7. ATTENUATOR TRACKING (+20 TO -60 dBm)

a. Connect equipment as in Figure 4-4 and set Model 25A to 0 dBm Full Scale and 100% F.S.

b. Set Test Attenuator to 0 dB position; RMS Voltmeter to 300 mV F.S.

c. Record D.C. Voltmeter reading.

d. Set Test Attenuator to -10 dB. Set the RMS Voltmeter to 100 mV, F.S. Using the voltages for 0 dBm and -10 dBm recorded in ¶4-6c to ¶4-6e compute the Test Attenuator's voltage ratio.

e. Change Model 25A to +20 dBm F.S. and RMS Voltmeter to 1 volt F.S. Record D.C. Voltmeter reading.

f. Change Model 25A to +10 dBm F.S. and Test Attenuator to 0 dB. Record D.C. Voltmeter reading.

g. Voltages in steps e. and f. should agree within ±0.57%.

h. Change Test Attenuator to -10 dB and down range RMS Voltmeter to 300 mV F.S. Record DC voltage.

i. Change Model 25A to 0 dBm and Test Attenuator to 0 dB position and record DC voltage. Again steps h. and i. should be within ±0.57%. This procedure is repeated until all ranges of the 25A are covered.

TABLE 4-2. TEST EQUIPMENT REQUIRED

INSTRUMENT TYPE	SPECIFICATION	RECOMMENDED
Micropotentiometer	DC to 1 MHz <0.1% Conversion Error	Ballantine Model 440
DC Digital Voltmeter	100 mV - 100 V F. S. 0.015% Accuracy	Fluke Model 8300A Option -10
DC Differential Voltmeter	100 µV F. S. Null Sensitivity	Fluke Model 881AB
1 MHz Generator	100 mV - 3 Volts rms from 50 Ω	Hewlett-Packard 651B
True RMS Voltmeter	1 mV - 3 V F. S., DC output 10 Volts at F. S. ±1% Accuracy at 1 MHz Input Impedance 2 MΩ, <25 pF	Boonton Model 93AD
Power Supply	0 - 4 VDC at 50 mA	Power Designs 5015T
Attenuator	0 - 120 dB	Hewlett-Packard 355D
Resistor	50.00 Ω, 1/2 W ±0.1%, 50 ppm	Pyrofilm PME70T2

Note that the accuracy of the attenuator is independent of full scale absolute voltage and that only the voltage ratios are measured. Agreement between any two attenuator steps should be better than ±0.57%. Any deviation of the Test Attenuator from 10.00 dB (¶4-7d), should be considered when computing absolute ratio errors.

TABLE 4-3. CALIBRATION LEVELS

DC Voltage	Resistor/ Thermocouple	25A Step
0.2236	22 Ω/10 mA	0 dBm
0.1993	22 Ω/10 mA	-1
0.1776	22 Ω/10 mA	-2
0.1583	22 Ω/10 mA	-3
0.1411	22 Ω/10 mA	-4
0.1257	2.2 Ω/50 mA	-5
0.1121	2.2 Ω/50 mA	-6
0.09988	2.2 Ω/50 mA	-7
0.08902	2.2 Ω/50 mA	-8
0.07934	2.2 Ω/50 mA	-9
0.07071	2.2 Ω/50 mA	-10

NOTE

RMS Voltmeter should be ranged down to 100 mV F.S. for -7, -8, -9, and -10 dB Steps.

4-8. CALIBRATION PROCEDURE. Remove instrument covers and oscillator P. C. board shield cover. The Model 25A should be turned on and allowed to warm up for several minutes before commencing adjustment.

NOTE

The % full scale switch should be set to 100 before proceeding.

4-9. POWER SUPPLY. Connect a digital voltmeter to the +15 volt test point located on the oscillator assembly shield. Adjust A3 R16 for a reading of +15.0 ±0.1 volts.

4-10. 0 dBm, -9 dBm ADJUSTMENT. Use procedure outlined in Section 4-6, a. through e., for 0 dBm and -9 dBm outputs only.

4-11. Connect equipment as shown in Figure 4-3. Set Model 25A output to 0 dBm. Note reading of DC voltmeter.

a. Adjust A3R4 until DC readings in ¶4-10 and ¶4-11 agree at 0 dBm.

b. Set Model 25A to -9 dBm. Note reading of DC Voltmeter.

c. Adjust A2R3 until DC readings in ¶4-10 and ¶4-11b agree at -9 dBm.

d. There will be a slight interaction between these adjustments. Repeat 4-11a. through c. until DC readings agree at 0 dBm and -9 dBm.

4-12. TROUBLESHOOTING. If faulty operation of the Model 25A is evident or if the calibration procedure in the preceding section fails to correct an inaccurate output, the following steps will

4-12. (Cont.)

help to isolate and correct the fault.

4-13. SCHEMATIC DIAGRAMS. The schematic diagrams located in the back of the manual show all electrical components, test points, waveforms, and DC voltages. Components which appear in the outlined areas are located on, or in, the assembly indicated within these areas. Any component not located in an outlined area is wired to the chassis or front or rear panel. External markings are indicated by a solid rectangle around the name of the control or connector.

Components which are identified on the schematic can be located on an assembly or circuit board by referring to the layout or drawing which appears on the page opposite the schematic drawing.

4-14. TROUBLESHOOTING PROCEDURE.

4-15. POWER SUPPLY AND REFERENCE CIRCUITS (A3). Proper operation of the power supply and reference circuits is indicated by correct DC voltage levels at indicated points in the circuits. Active device failure is most likely. Since all active devices are in sockets, simple replacement will usually correct the problem. Any device replacement in these circuits requires that the Model 25A be recalibrated.

4-16. OSCILLATOR AND AGC SYSTEM (A2). A2 IC1 generates the 1 MHz signal which ultimately appears at the output connector.

All signals and DC voltages are TTL levels. Pin 14 of A2 IC1 should be approximately 5 VDC which is supplied by A2 Q1. A2 IC1 may be replaced without recalibration. A2 Q3 and A2 Q4 provide power to amplifier A2 Q2 and would be suspect if improper waveforms appear at test point 3 or 4. These may be replaced without recalibration. A low or high output power on all ranges may be caused by failure of A2 A2. The DC voltages at pins 2 and 3 must be equal for proper operation. Recalibration is necessary when A2 A2 is replaced.

4-17. ATTENUATOR ASSEMBLY (A1). A malfunction in the precision attenuator would be indicated by incorrect output power on one or more of the full scale output settings. By noting the incorrect full scale switch positions and the switching sequence shown on the schematic diagram, a defective resistor or switch contact may quickly be isolated. After component replacement or switch repair, attenuator tracking should be checked. Note that the attenuator switch shield must be properly installed before tracking measurements are attempted.

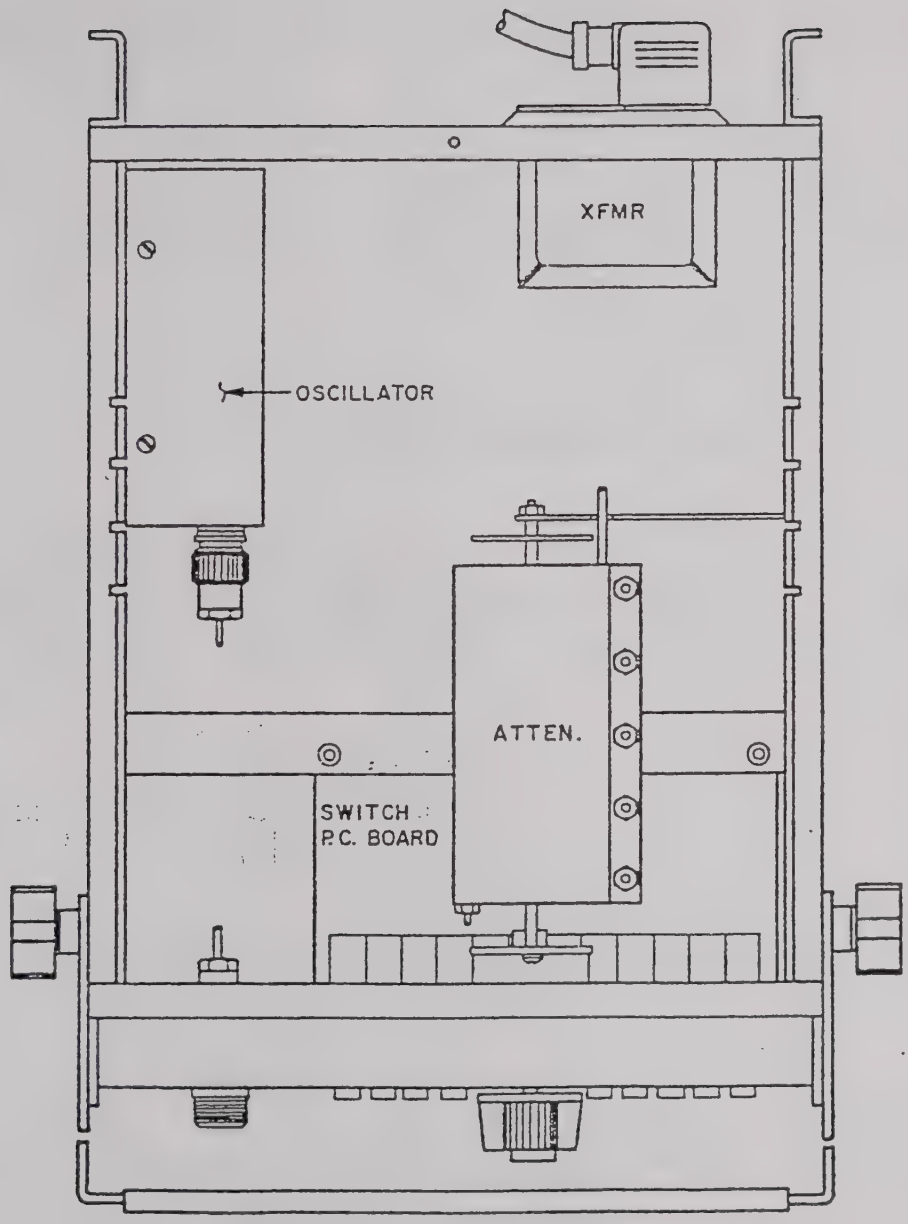


FIGURE 4-1. LOCATION OF PRINCIPAL SUB-ASSEMBLIES

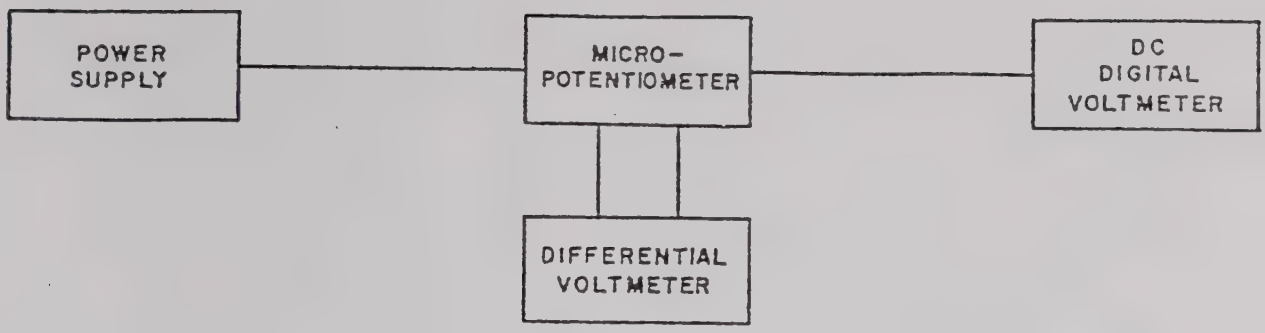


Figure 4-2A

DC MICROPOTENTIOMETER TEST SET-UP

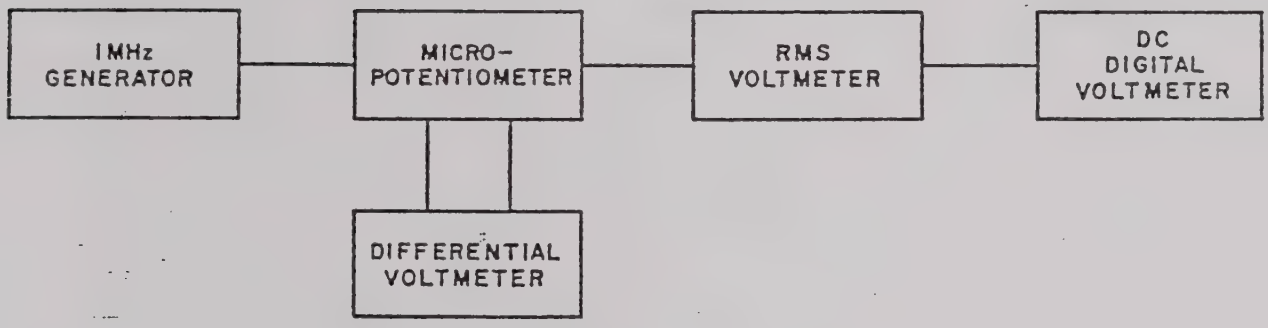


Figure 4-2B

AC MICROPOTENTIOMETER TEST SET-UP

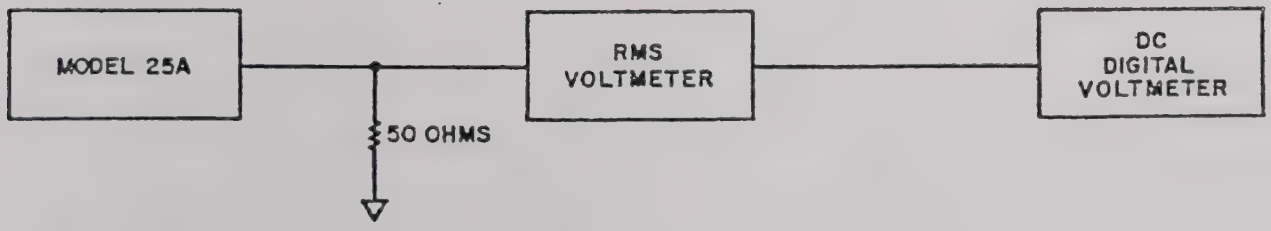


Figure 4-3

MODEL 25A DOWNSCALE TEST SET-UP

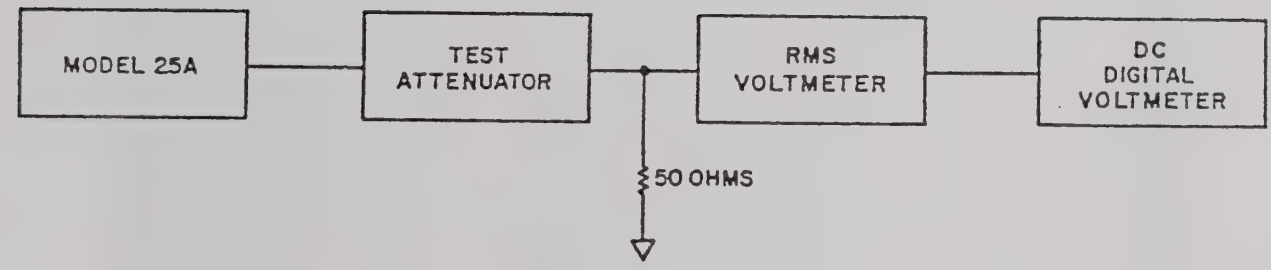


Figure 4-4
ATTENUATOR TRACKING TEST SET-UP

TABLE OF REPLACEABLE PARTS

Reference		Description	BEC Part No.
		REAR PANEL	
F1	Fuse, Slo-Blo	0.10 A 100/120 V	545519
F1	Fuse, Slo-Blo	0.06 A 200/240 V	545518
P1	Connector, Voltage Selector	Corcom No. 6J1	483197
T1	Power Transformer	Boonton Electronics	446071
		SUB PANEL	
CR1	Diode, LED	MV5025	536000
J3	Connector, TNC to N	Gremar No. 6098-Z	481009
S1	Line Switch	Microswitch No. 8A2011	465202
		ATTENUATOR (A1)	
P2	Plug, TNC	Specialty No. 24P104-2	477292
P3	Plug, TNC	Specialty No. 24P104-2	477292
R1	Resistor, MF	53.27 Ω 0.1% 1/2 W	326999
R2	Resistor, MF	789.8 Ω 0.1% 1/2 W	326994
R3	Resistor, MF	53.27 Ω 0.1% 1/2 W	326999
R4	Resistor, MF	53.27 Ω 0.1% 1/2 W	326999
R5	Resistor, MF	789.8 Ω 0.1% 1/2 W	326994
R6	Resistor, MF	53.27 Ω 0.1% 1/2 W	326999
R7	Resistor, MF	61.11 Ω 0.1% 1/2 W	326998
R8	Resistor, MF	247.5 Ω 0.1% 1/2 W	326995
R9	Resistor, MF	61.11 Ω 0.1% 1/2 W	326998
R10	Resistor, MF	96.25 Ω 0.1% 1/2 W	326996
R11	Resistor, MF	71.15 Ω 0.1% 1/2 W	326997
R12	Resistor, MF	96.25 Ω 0.1% 1/2 W	326996
S1	Switch, Rotary	Oak Type N	466242
		OSCILLATOR (A2)	
C1 through C4	Capacitor, Feedthru	1000 pF 20% 500 V	227105
J1	Connector	Molex	479258
J2	Jack, TNC	Specialty No. 24JK120-2	479304
		OSCILLATOR PC BOARD (A2)	
A1	Op. Amp.	CA3130S	535032
A2	Op. Amp.	CA3130S	535032
C1	Capacitor, Cer.	0.1 µF +80%/-20% 25 V	224124
C2	Capacitor, Elec.	10 µF 20% 20 V	283205
C3	Capacitor, Mica	200 pF 5% 500 V	200004
C4	Capacitor, Cer.	0.1 µF +80%/-20% 25 V	224124
C5	Capacitor, Mica	200 pF 5% 500 V	200004
C6	Capacitor, Elec.	10 µF 20% 20 V	283205
C7	Capacitor, Mica	47 pF 5% 300 V	205018
C8	Capacitor, PC	0.01 µF 10% 400 V	234126
C9	Capacitor, Mica	240 pF 5% 500 V	200506
C10	Capacitor, Mica	390 pF 5% 500 V	200108
C11	Capacitor, Mica	2700 pF 5% 500 V	200517
C12	Capacitor, Mica	3900 pF 5% 500 V	200523
C13	Capacitor, Mica	3900 pF 5% 500 V	200523
C14	Capacitor, Mica	2700 pF 5% 500 V	200517
CR1	Diode, Zener	1N825A (6.2 V)	530155
CR2	Diode, Pair	Selected	530163
CR3	Diode, Sig.	1N914	530058
CR4	Diode, Pair	Selected	530163

TABLE OF REPLACEABLE PARTS (CONT.)

Reference		Description	BEC Part No.
IC1	Integrated Circuit	SN7400N(Quad 2 Input NAND Gate)	534034
L1	Choke	5.6 µH 10%	400296
L2	Choke	100 µH 5%	400295
L3	Choke	470 µH 5%	400116
L4	Choke	100 µH 5%	400295
L5	Choke	15 µH 10%	400175
L6	Choke	15 µH 10%	400175
L7	Choke	15 µH 10%	400175
Q1	Transistor, FET	MPSA12	528052
Q2	Transistor, NPN	2N3866	528116
Q3	Transistor, NPN	MPS U05	528081
Q4	Transistor, NPN	2N3903	528024
R1	Resistor, MF	1.1 kΩ 1%	341304
R2	Resistor, Comp.	2 kΩ 5%	343329
R3	Resistor, Var.	100 kΩ 10% 1 W	311366
R4	Resistor, Comp.	510 Ω 5%	343268
R5	Resistor, MF	49.9 kΩ 1%	341467
R6	Resistor, Comp.	510 Ω 5%	343268
R7	Resistor, MF	4.99 kΩ 1%	341367
R8	Resistor, Comp.	47 kΩ 5%	343465
R9	Resistor, Comp.	33 kΩ 5%	343450
R10	Resistor, Comp.	2 kΩ 5%	343329
R11	Resistor, MF	232 kΩ 1%	341535
R12	Resistor, Comp.	220 Ω 5% 2 W	304071
R13	Resistor, Comp.	10 kΩ 5%	343400
R14	Resistor, Comp.	3 kΩ 5%	343346
R15	Resistor, MF	1.1 kΩ 1%	341304
R16	Resistor, Comp.	5.6 Ω 5%	343072
R17	Resistor, MF	1 MΩ 1%	342600
R18	Resistor, MF	1 MΩ 1%	342600
R19	Resistor, MF	10 kΩ 1%	341400
R20	Resistor, MF	50.00 Ω 0.1% 1 W	326993
R21	Resistor, Comp.	10 kΩ 5%	343400
Y1	Crystal	1 MHz 0.01%	547029
		SWITCH PC BOARD (A3)	
A1	Op. Amp.	LM301AN	535012
C1	Capacitor, Elec.	250 µF 40 V	283207
C2	Capacitor, Cer.	33 pF 5% 1000 V	224139
C3	Capacitor, Elec.	10 µF 20% 20 V	283205
CR1	Bridge, Rectifier	VE68	532011
CR2	Diode, Sig.	1N4001	530151
CR3	Diode, Zener	1N821 (6.2 V)	530050
CR4	Diode, Sig.	1N4001	530151
IC1	Integrated Circuit	µA7805UC 5 V Regulator	535011
R1	Resistor, MF	1.1 kΩ 1%	341304
R2	Resistor, Comp.	750 Ω 5%	344284
R3	Resistor, MF	1.1 kΩ 1%	341304
R4	Resistor, Var.	5 kΩ 10% 1 W	311268
R5	Resistor, MF	1.400 kΩ 0.1% 1/4 W	325909
R6	Resistor, MF	1.248 kΩ 0.1% 1/4 W	325908
R7	Resistor, MF	1.112 kΩ 0.1% 1/4 W	325907
R8	Resistor, MF	991.1 Ω 0.1% 1/4 W	325906
R9	Resistor, MF	883.4 Ω 0.1% 1/4 W	325905
R10	Resistor, MF	787.2 Ω 0.1% 1/4 W	325904
R11	Resistor, MF	701.7 Ω 0.1% 1/4 W	325903
R12	Resistor, MF	625.3 Ω 0.1% 1/4 W	325902
R13	Resistor, MF	557.4 Ω 0.1% 1/4 W	325901
R14	Resistor, MF	4.568 kΩ 0.1% 1/4 W	325910
R15	Resistor, MF	1.1 kΩ 1%	341304

TABLE OF REPLACEABLE PARTS (CONT.)

Reference		Description	BEC Part No.
R16	Resistor, Var.	200 Ω 10% 1 W	311269
R17	Resistor, MF	750 Ω 1%	341284
S1	Switch, Pushbutton	Centralab Type PB-10(Modified)	465205

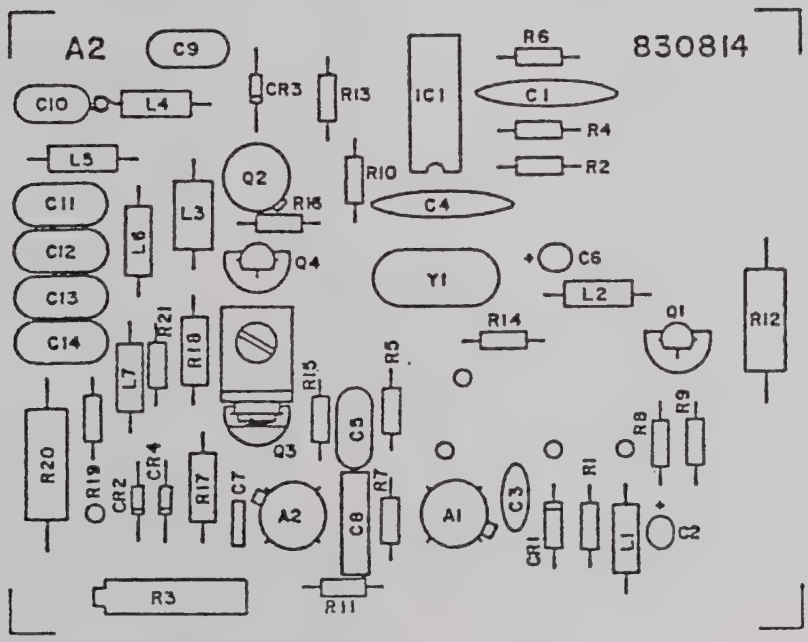
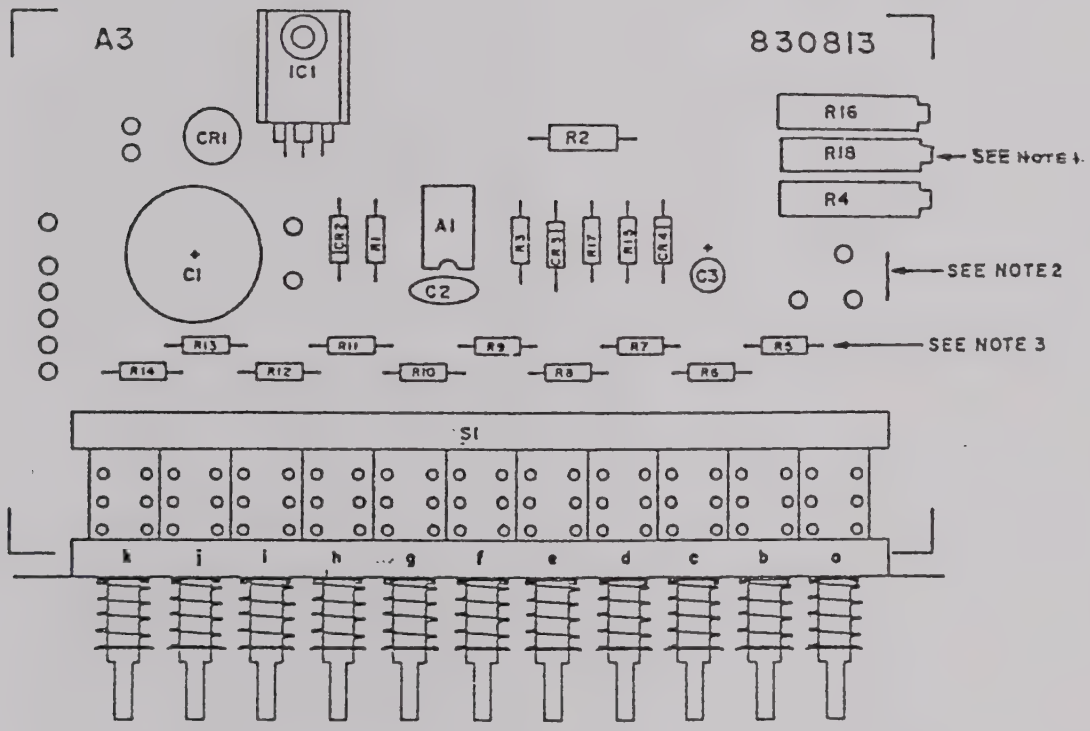


Figure 6-1

Oscillator P.C. Board A2



NOTES:
1. R18 IS USED ON MODEL 26A ONLY.
2. THIS JUMPER USED ON MODEL 25A ONLY.
3. ON MODEL 25A, R5 IS REPLACED BY A JUMPER.

Figure 6-2

Switch P.C. Board A3

WARRANTY

Boonton Electronics Corporation warrants its products to the original purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of one year from date of shipment, provided they are used under normal operating conditions. This warranty does not apply to active devices that have given normal service, to sealed assemblies which have been opened or to any item which has been repaired or altered without our authorization.

We will repair, or at our option, replace any of our products which are found to be defective under the terms of this warranty.

There will be no charge for parts, labor, or forward and return normal ground transportation during the first three months of this warranty.*

There will be no charge for parts, labor, or return normal ground transportation during the fourth through twelfth month of this warranty.*

Except for such repair or replacement, we will not be liable for any incidental damages or for any consequential damages, as those terms are defined in Section 2-715 of the Uniform Commercial Code, in connection with products covered by this warranty.

*For *overseas shipments*, there will be no charge for Air Freight during these specified time periods.

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TELEPHONE: (201) 584-1077 ■ TLX: 710-986-8215 BOONTRONICS ■ FAX: (201) 584-3037

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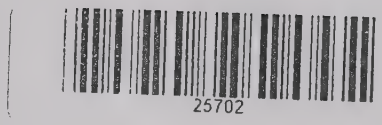

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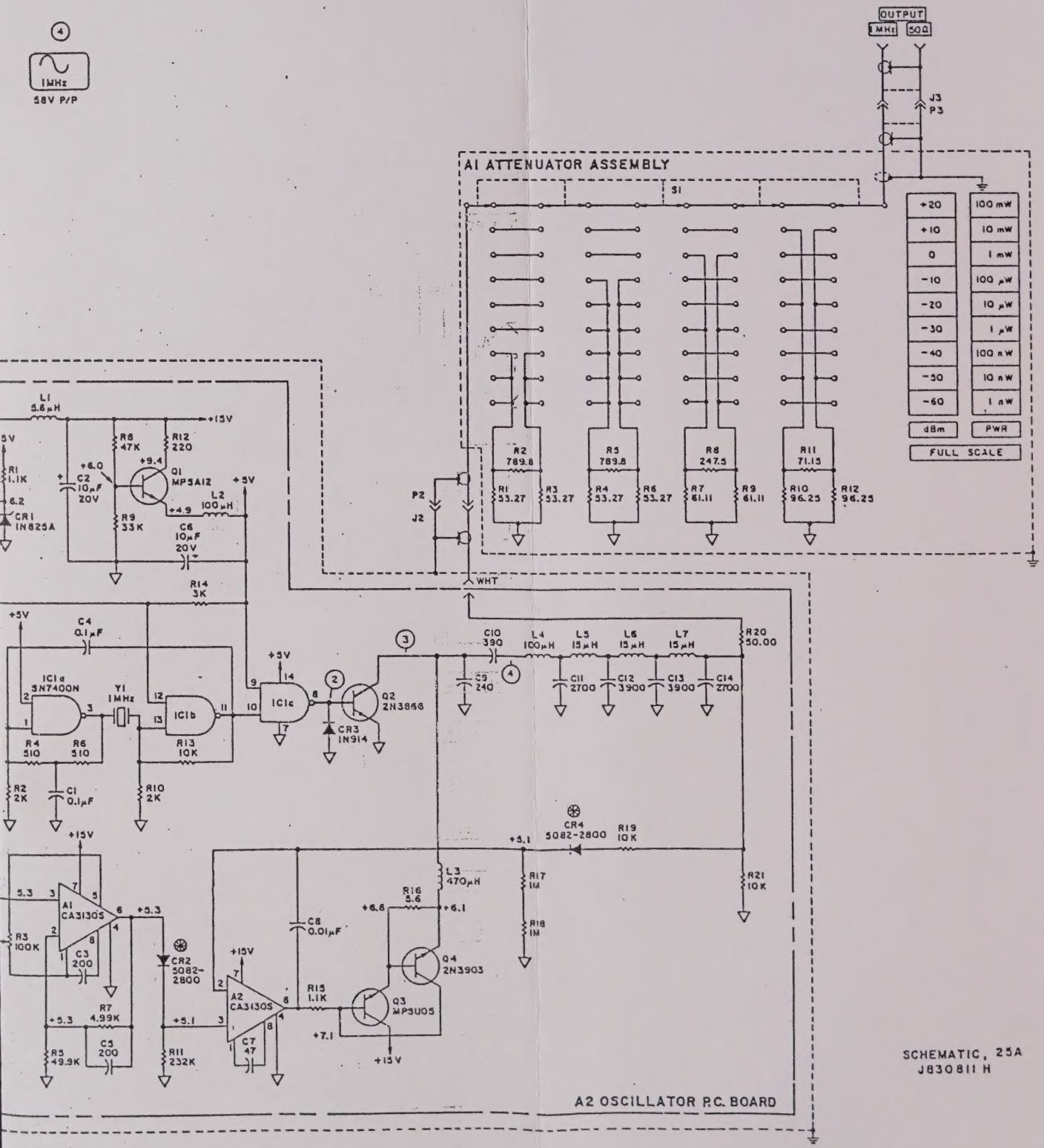
FAX: (201) 584-3037

NOTES:

1. ALL RESISTANCE VALUES IN OHMS.
2. CAPACITANCE VALUES IN pF, UNLESS OTHERWISE SPECIFIED.
3. ⊛ SELECTED VALUE
4. ▭ EXTERNAL MARKINGS
5. ——— FEEDBACK PATH
6. ——— SIGNAL PATH
7. TEST CONDITIONS:
   RANGE: +20 dBm
   ALL VOLTAGE READINGS IN VOLTS UNLESS OTHERWISE SPECIFIED.
   ALL READINGS NOMINAL.
8. LAST NUMBERS USED IN A1:
   R12
9. LAST NUMBERS USED IN A2:
   R21, C14, L7, CR4
10. LAST NUMBERS USED IN A3:
    R17



SCHEMATIC, 25A
J830811 H

Figure 6-3
Mainframe Schematic

MP MASTER
MA24335